



# Enzymes

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## In this lecture

- 1- What are enzymes and their importance for living cells
- 2- General properties of enzymes
- 3- Nomenclature of enzymes
- 4- Specificity of enzymes

# Enzymes

- Importance of enzymes for living cells

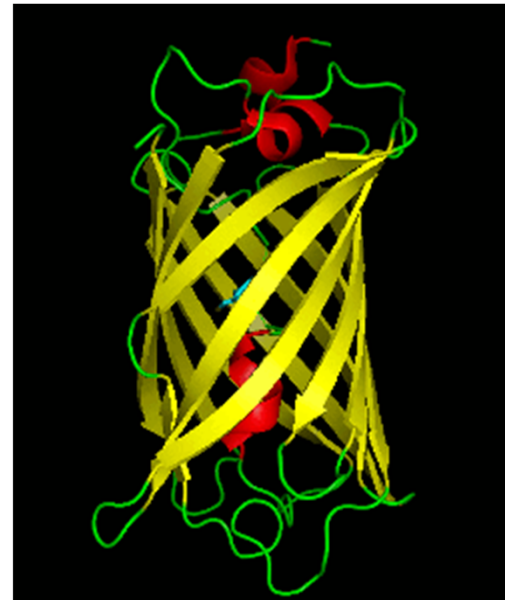
1. Catalyze biochemical reactions of the cell: they can speed up the rate of reactions by order of  $10^7$  .

**Turnover number:** number of substrate molecules metabolized by **one** enzyme molecule per **time unit**.

2. Control the rate of biochemical pathways

- Chemical nature of enzymes

Enzymes are mostly of protein nature



# Enzymes

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Some RNA molecules have catalytic activity and they are called ***Ribozymes***



# Enzymes

## General properties of enzymes:

1. Enzymes are active at very small amounts
2. Enzymes are not affected by the reactions they catalyze
3. Enzymes are proteinic in nature and their activities are affected by temperature, pH value, salt conc. etc....
4. Enzymatic catalysis doesnot affect the equilibrium point of reversible reaction
5. Enzymes exhibit specificity for the reactions they catalyze. Specificity can be narrow or wide depending on the nature of the enzyme



# Enzymes

## Nomenclature of enzymes

- Enzymes are named by adding **-ase** to the end of:
  - The substrate of the enzyme. **e.g. urease**
  - Name of the group to which substrate belongs. **e.g. Lipases**
  - Name of the type of the reaction they catalyze. **e.g. hydrolases**
- Some old names are still used  
**e.g. Pepsin, chymotrypsin, papain etc...**

# Enzymes

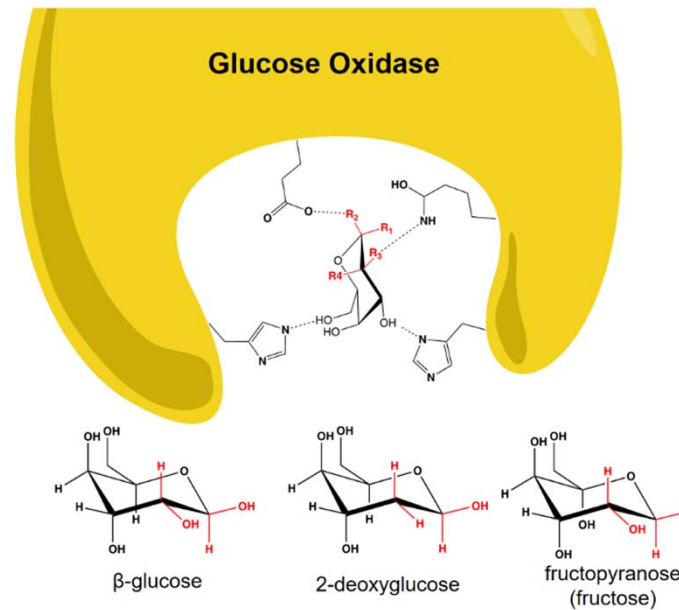
## Enzyme specificity

Specificity of enzymes is due to uniqueness of the **active site** in terms of

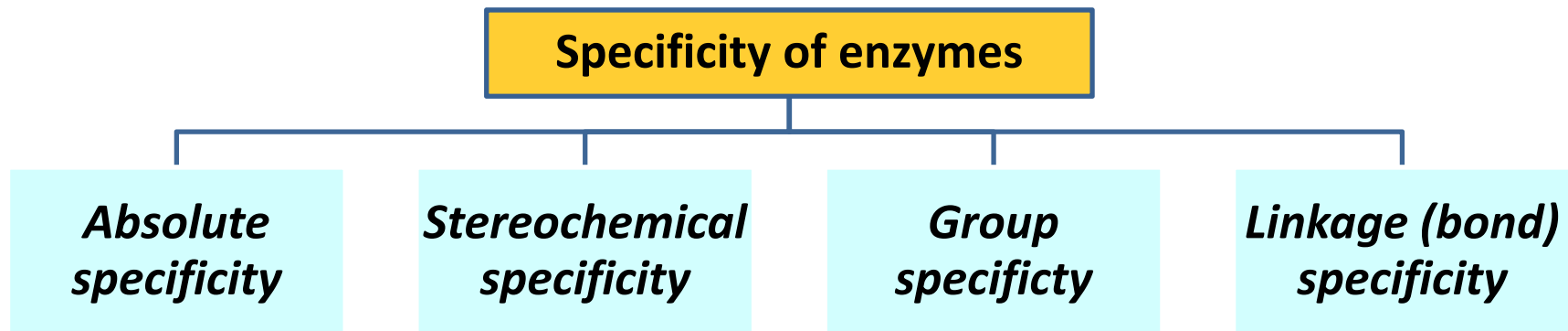
1- **its chemical nature**

2- **its electrical charges and their arrangement**

3- **spatial arrangement of chemical groups** located in the active site



# Enzymes



## 1- Absolute specificity

Only one substrate for the enzyme



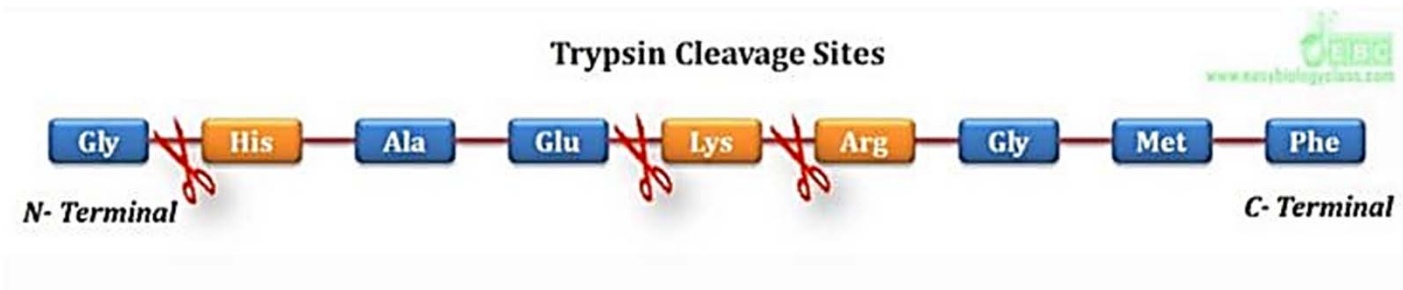


# Enzymes

## 3- group specificity

*the enzyme is specific to a bond and groups surrounding the bonds*

*e.g. Trypsin hydrolyzes a peptide bond in which amino group is contributed by any basic amino acid such as lysine, arginine and histidine*





# Enzymes

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## 4- Bond (linkage) specificity

*the enzyme is specific to a specific bond irrespective of the rest of the substrate structure*

*e.g.  $\alpha$ -amylase enzyme* can hydrolyze  **$\alpha$ -1-4 glycosidic** linkage in starch and glycogen, i.e., the enzyme is specific only to  $\alpha$ -1-4 glycosidic bond and not to the substrate

*e.g. lipase* can hydrolyze **ester bonds** formed between glycerol and any fatty acid in lipids and fats whatever the type of the lipid or fat

# Enzymes

## Structure and composition of enzymes

Protein structure

Simple enzymes: *Only protein*

Compound enzymes =

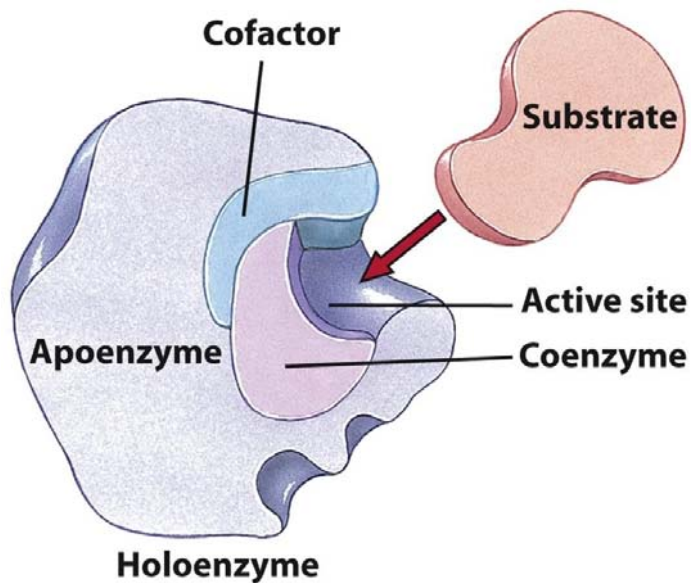
protein

+

Non protein component

apoenzyme

holoenzyme



# Enzymes

## Non protein component

### coenzyme

- small organic molecule (Many are vitamins)
- Bind *reversibly* to protein part
- Participate in the catalysis
- *e.g.* NAD – NADP – FAD – FMN - *Coenzyme A*

### prosthetic group

- small organic molecule
- Bind *tightly* to protein part
- Participate in the catalysis
- *e.g.* Heme group in catalase

### Metal ion (activator)

- *e.g.* Cu – Mg – Fe – Zn  
Ca – Mn -Co
- Participate in the catalysis
- Bind directly to amino acids side chains or bind to prosthetic group
- Proteins containing metals are called metalloproten (metalloenzyme)